

Annexe B - Examen Données Catégorielles : Exploration, Modélisation, 12 décembre 2022

A - Table 1

```
library(FactoMineR)
library(factoextra)

## Le chargement a nécessité le package : ggplot2

## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa

data.IQS=read.csv2("K:\\myhome\\Documents\\DC\\examen\\2223\\data\\data.txt",row.name=1, header=T)
colnames(data.IQS)<-c("[54.2,91.3[", "[91.3,99.9[", "[99.9,107[", "[107,116[", "[116,156]")
data.IQS

## [54.2,91.3[ [91.3,99.9[ [99.9,107[ [107,116[ [116,156]
## AIX-MARSEILLE      301       166       169       251       274
## AMIENS            407       273       224       168       111
## BESANCON          119       172       157       183        87
## BORDEAUX          220       387       408       344       311
## CLERMONT-FERRAND  116       219       236       206       113
## CORSE              50        47        41        19        16
## CRETEIL           501       189       185       245       338
## DIJON              177       242       240       207       119
## GRENOBLE          228       252       400       544       527
## LILLE              836       392       283       247       318
## LIMOGES            65        96        120       93        26
## LYON               277       211       264       350       444
## MONTPELLIER        265       252       294       292       186
## NANCY-METZ         311       313       258       224       156
## NANTES             314       541       519       452       363
## NICE                132       96        157       141       174
## NORMANDIE          370       453       387       343       202
## ORLEANS-TOURS       255       293       269       282       205
## PARIS              46        39        39        57        276
## POITIERS           148       295       223       193       116
## REIMS              215       194       150       111        65
## RENNES             230       450       487       440       343
## STRASBOURG         119       113       144       213       199
## TOULOUSE           193       314       388       429       355
## VERSAILLES          335       178       168       264       912
```

B - Test du chi2

```
test=chisq.test(data.IQS)
test

## 
## Pearson's Chi-squared test
##
## data: data.IQS
## X-squared = 4037, df = 96, p-value < 2.2e-16
```

C - Profils lignes et colonnes

```
pligne=prop.table(as.matrix(data.IQS),1);round(pligne,3)
```

```
## [54.2,91.3[ [91.3,99.9[ [99.9,107[ [107,116[ [116,156]
## AIX-MARSEILLE 0.259 0.143 0.146 0.216 0.236
## AMIENS 0.344 0.231 0.189 0.142 0.094
## BESANCON 0.166 0.240 0.219 0.255 0.121
## BORDEAUX 0.132 0.232 0.244 0.206 0.186
## CLERMONT-FERRAND 0.130 0.246 0.265 0.231 0.127
## CORSE 0.289 0.272 0.237 0.110 0.092
## CRETEIL 0.344 0.130 0.127 0.168 0.232
## DIJON 0.180 0.246 0.244 0.210 0.121
## GRENOBLE 0.117 0.129 0.205 0.279 0.270
## LILLE 0.403 0.189 0.136 0.119 0.153
## LIMOGES 0.162 0.240 0.300 0.232 0.065
## LYON 0.179 0.136 0.171 0.226 0.287
## MONTPELLIER 0.206 0.196 0.228 0.227 0.144
## NANCY-METZ 0.246 0.248 0.204 0.177 0.124
## NANTES 0.143 0.247 0.237 0.206 0.166
## NICE 0.189 0.137 0.224 0.201 0.249
## NORMANDIE 0.211 0.258 0.221 0.195 0.115
## ORLEANS-TOURS 0.196 0.225 0.206 0.216 0.157
## PARIS 0.101 0.085 0.085 0.125 0.604
## POITIERS 0.152 0.303 0.229 0.198 0.119
## REIMS 0.293 0.264 0.204 0.151 0.088
## RENNES 0.118 0.231 0.250 0.226 0.176
## STRASBOURG 0.151 0.143 0.183 0.270 0.253
## TOULOUSE 0.115 0.187 0.231 0.256 0.211
## VERSAILLES 0.180 0.096 0.090 0.142 0.491
```

```
pcol=prop.table(as.matrix(data.IQS),2);round(pcol,3)
```

```
## [54.2,91.3[ [91.3,99.9[ [99.9,107[ [107,116[ [116,156]
## AIX-MARSEILLE 0.048 0.027 0.027 0.040 0.044
## AMIENS 0.065 0.044 0.036 0.027 0.018
## BESANCON 0.019 0.028 0.025 0.029 0.014
```

## BORDEAUX	0.035	0.063	0.066	0.055	0.050
## CLERMONT-FERRAND	0.019	0.035	0.038	0.033	0.018
## CORSE	0.008	0.008	0.007	0.003	0.003
## CRETEIL	0.080	0.031	0.030	0.039	0.054
## DIJON	0.028	0.039	0.039	0.033	0.019
## GRENOBLE	0.037	0.041	0.064	0.086	0.085
## LILLE	0.134	0.063	0.046	0.039	0.051
## LIMOGES	0.010	0.016	0.019	0.015	0.004
## LYON	0.044	0.034	0.043	0.056	0.071
## MONTPELLIER	0.043	0.041	0.047	0.046	0.030
## NANCY-METZ	0.050	0.051	0.042	0.036	0.025
## NANTES	0.050	0.088	0.084	0.072	0.058
## NICE	0.021	0.016	0.025	0.022	0.028
## NORMANDIE	0.059	0.073	0.062	0.054	0.032
## ORLEANS-TOURS	0.041	0.047	0.043	0.045	0.033
## PARIS	0.007	0.006	0.006	0.009	0.044
## POITIERS	0.024	0.048	0.036	0.031	0.019
## REIMS	0.035	0.031	0.024	0.018	0.010
## RENNES	0.037	0.073	0.078	0.070	0.055
## STRASBOURG	0.019	0.018	0.023	0.034	0.032
## TOULOUSE	0.031	0.051	0.062	0.068	0.057
## VERSAILLES	0.054	0.029	0.027	0.042	0.146

D - Contributions au chi2

```
tab1=test$res^2; total.l=apply(test$res^2,1,sum)
tab2=cbind(tab1,total.l);total.c=apply(tab2,2,sum)
tab.contrib=rbind(tab2,total.c)
round(tab.contrib,3)
```

##	[54.2,91.3[[91.3,99.9[[99.9,107[[107,116[[116,156]
## AIX-MARSEILLE	20.390	17.913	16.849	1.128	7.440
## AMIENS	122.737	6.293	0.594	21.181	66.847
## BESANCON	4.213	6.165	1.343	9.862	22.394
## BORDEAUX	38.904	9.420	16.933	0.120	1.625
## CLERMONT-FERRAND	21.592	10.244	19.340	3.775	23.835
## CORSE	6.856	4.698	1.230	7.298	10.024
## CRETEIL	150.390	34.665	38.406	8.404	7.290
## DIJON	2.029	11.157	9.698	0.310	31.000
## GRENOBLE	67.416	47.017	0.315	56.703	47.662
## LILLE	426.516	0.938	41.374	71.075	22.915
## LIMOGES	2.812	3.509	20.326	1.819	36.517
## LYON	3.351	29.788	6.338	4.484	58.463
## MONTPELLIER	0.202	0.051	5.338	3.782	20.112
## NANCY-METZ	13.609	15.737	0.164	3.802	36.964
## NANTES	35.001	26.346	15.642	0.201	12.908
## NICE	0.457	13.200	2.183	0.002	8.186
## NORMANDIE	1.030	31.679	3.942	0.394	63.469
## ORLEANS-TOURS	0.129	4.584	0.315	1.279	12.032
## PARIS	22.549	29.404	29.799	13.559	372.145
## POITIERS	11.326	53.461	4.218	0.086	32.122

```

## REIMS           31.461    15.977    0.082    9.514    45.852
## RENNES          65.633    10.372    24.839    5.310    5.747
## STRASBOURG     9.452     11.974    1.091    18.090   10.788
## TOULOUSE        60.719    1.077     8.484    23.622    1.061
## VERSAILLES      3.565     98.273   110.437   33.079   785.146
## total.c         1122.338  493.942   379.279   298.880  1742.544
##
## total.1
## AIX-MARSEILLE  63.720
## AMIENS          217.651
## BESANCON        43.977
## BORDEAUX        67.003
## CLERMONT-FERRAND 78.786
## CORSE           30.105
## CRETTEIL        239.156
## DIJON            54.194
## GRENOBLE        219.112
## LILLE            562.819
## LIMOGES          64.983
## LYON             102.423
## MONTPELLIER     29.484
## NANCY-METZ       70.277
## NANTES           90.098
## NICE              24.028
## NORMANDIE        100.514
## ORLEANS-TOURS    18.338
## PARIS            467.456
## POITIERS         101.213
## REIMS            102.886
## RENNES           111.902
## STRASBOURG      51.395
## TOULOUSE          94.962
## VERSAILLES        1030.500
## total.c          4036.983

```

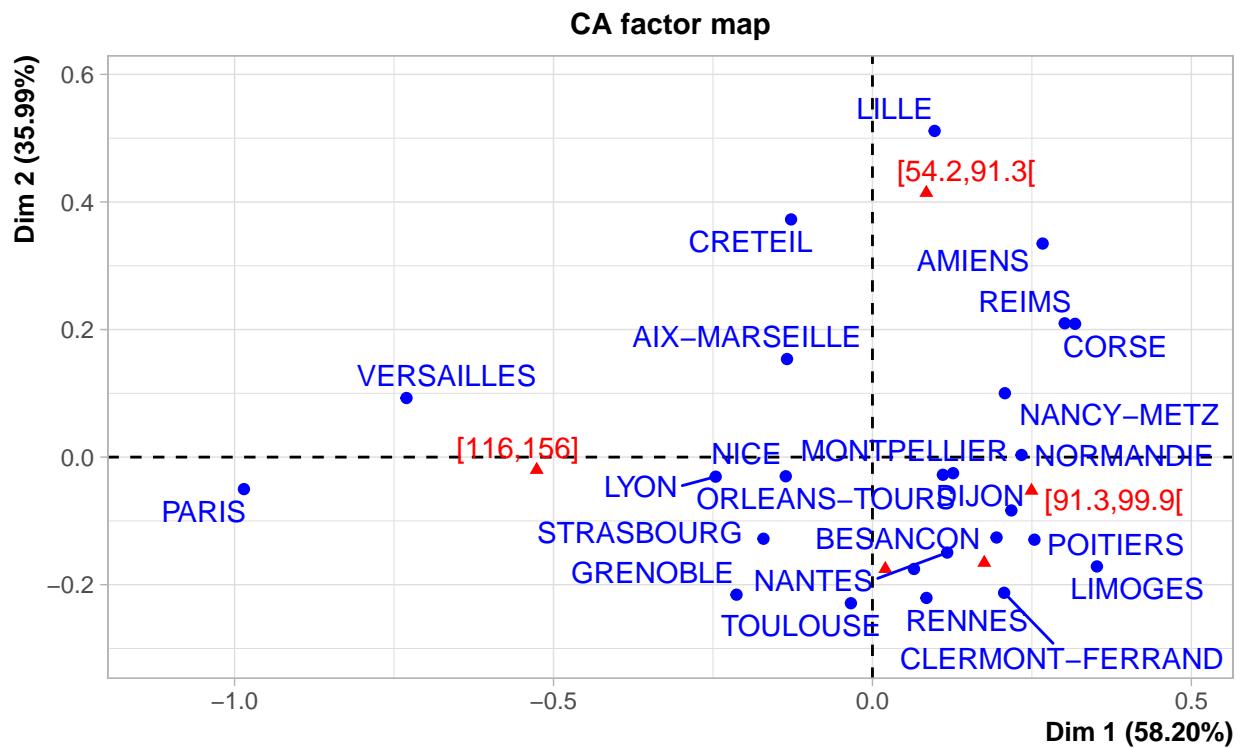
E - AFC et graphique du premier plan factoriel

```
AFC=CA(data.IQS)
```

```

## Warning: ggrepel: 3 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps

```



F - Inertie totale et inertie des axes

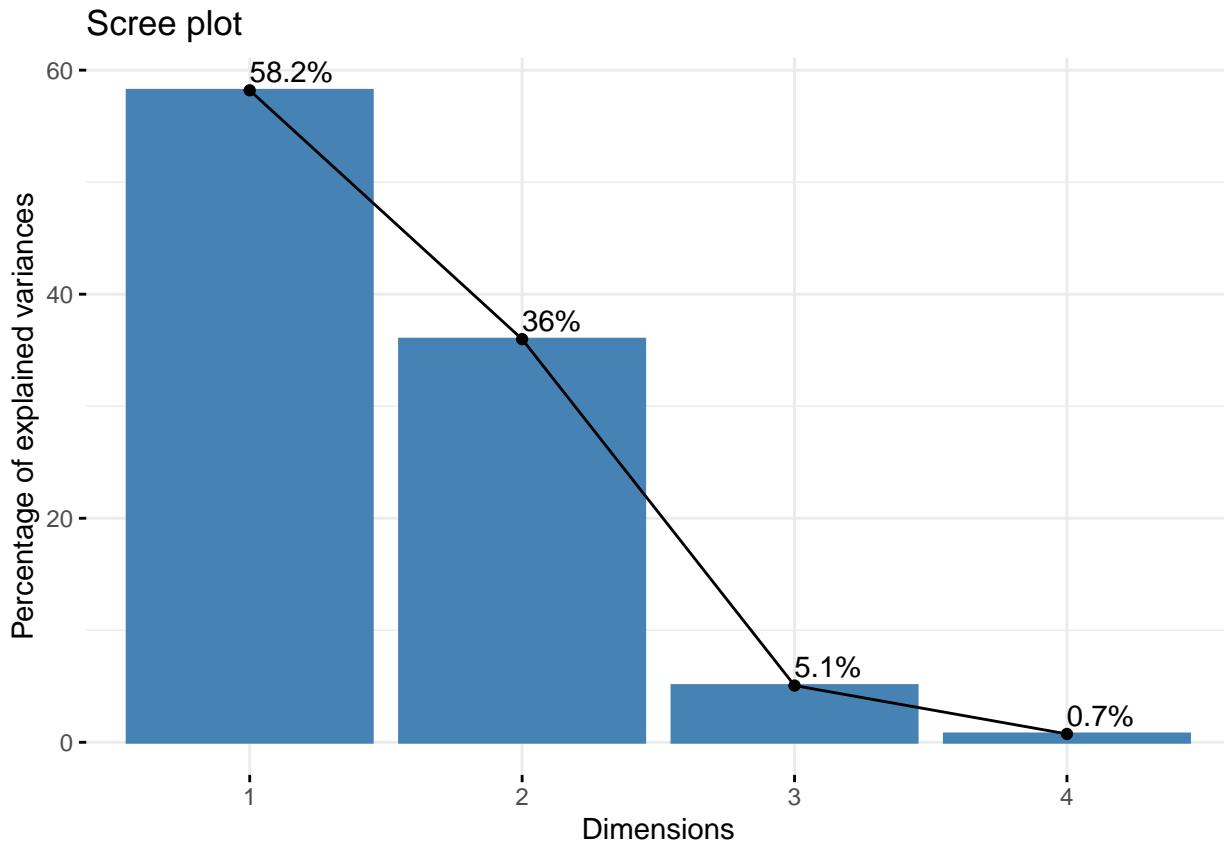
```
I=sum(AFC$eig[,1]);I
```

```
## [1] 0.129594
```

```
AFC$eig
```

```
##          eigenvalue percentage of variance cumulative percentage of variance
## dim 1 0.075422232      58.1988472           58.19885
## dim 2 0.0466387015     35.9883141           94.18716
## dim 3 0.0065659397      5.0665455          99.25371
## dim 4 0.0009671514      0.7462932         100.00000
```

```
fviz_eig(AFC, addlabels=T)
```



G - Sorties relatives aux points-lignes

```
AFC$call$marge.row
```

```
##      AIX-MARSEILLE          AMIENS        BESANCON       BORDEAUX
## 0.037270072 0.037976309 0.023049019 0.053609836
## CLERMONT-FERRAND           CORSE        CRETEIL        DIJON
## 0.028570511 0.005553594 0.046804276 0.031620173
## GRENOBLE                  LILLE        LIMOGES        LYON
## 0.062630413 0.066643125 0.012840679 0.049629225
## MONTPELLIER               NANCY-METZ    NANTES        NICE
## 0.041379089 0.040512343 0.070270617 0.022471189
## NORMANDIE                 ORLEANS-TOURS  PARIS         POITIERS
## 0.056338480 0.041860614 0.014670476 0.031299156
## REIMS                      RENNES        STRASBOURG    TOULOUSE
## 0.023594748 0.062598311 0.025296138 0.053898751
## VERSAILLES
## 0.059612854
```

```
axe1.r=cbind(C1=AFC$row$coord[,1],CTR1=AFC$row$contrib[,1],QLT1=AFC$row$cos2[,1])
round(axe1.r,3)
```

```

##          C1    CTR1   QLT1
## AIX-MARSEILLE -0.134  0.887  0.327
## AMIENS        0.267  3.585  0.387
## BESANCON      0.195  1.157  0.618
## BORDEAUX      0.065  0.301  0.106
## CLERMONT-FERRAND 0.206  1.615  0.481
## CORSE         0.318  0.743  0.580
## CRETEIL       -0.128  1.010  0.099
## DIJON          0.218  1.988  0.862
## GRENOBLE      -0.213  3.771  0.404
## LILLE          0.097  0.840  0.035
## LIMOGES        0.352  2.108  0.762
## LYON           -0.246  3.974  0.912
## MONTPELLIER   0.126  0.877  0.699
## NANCY-METZ     0.208  2.315  0.774
## NANTES         0.117  1.280  0.334
## NICE            -0.136  0.550  0.538
## NORMANDIE      0.234  4.081  0.954
## ORLEANS-TOURS  0.110  0.677  0.867
## PARIS          -0.985 18.886  0.949
## POITIERS       0.254  2.676  0.621
## REIMS          0.302  2.844  0.649
## RENNES          0.085  0.595  0.125
## STRASBOURG     -0.171  0.979  0.447
## TOULOUSE        -0.034  0.082  0.020
## VERSAILLES     -0.731 42.179  0.962

```

```

axe2.r=cbind(C2=AFC$row$coord[,2],CTR2=AFC$row$contrib[,2],QLT2=AFC$row$cos2[,2])
round(axe2.r,3)

```

```

##          C2    CTR2   QLT2
## AIX-MARSEILLE 0.154  1.889  0.431
## AMIENS        0.335  9.126  0.609
## BESANCON      -0.126  0.785  0.259
## BORDEAUX      -0.175  3.536  0.767
## CLERMONT-FERRAND -0.213  2.772  0.511
## CORSE          0.209  0.520  0.251
## CRETEIL        0.373  13.935  0.847
## DIJON          -0.084  0.474  0.127
## GRENOBLE      -0.216  6.247  0.414
## LILLE          0.511  37.371  0.965
## LIMOGES        -0.171  0.809  0.181
## LYON           -0.031  0.100  0.014
## MONTPELLIER   -0.025  0.056  0.028
## NANCY-METZ     0.100  0.872  0.180
## NANTES         -0.150  3.375  0.544
## NICE            -0.030  0.043  0.026
## NORMANDIE      0.003  0.001  0.000
## ORLEANS-TOURS  -0.028  0.069  0.055
## PARIS          -0.050  0.079  0.002
## POITIERS       -0.129  1.125  0.161
## REIMS          0.210  2.226  0.314
## RENNES          -0.221  6.541  0.849
## STRASBOURG     -0.128  0.889  0.251

```

```

## TOULOUSE      -0.229  6.064  0.928
## VERSAILLES    0.093   1.097  0.015

```

H - Sorties relatives aux points-colonnes

```
AFC$call$marge.col
```

```

## [54.2,91.3[ [91.3,99.9[ [99.9,107[ [107,116[ [116,156]
## 0.1999936   0.1982922   0.1993515   0.2021765   0.2001862

```

```

axe1.c=cbind(C1=AFC$col$coord[,1],CTR1=AFC$col$contrib[,1],QLT1=AFC$col$cos2[,1])
round(axe1.c,3)

```

```

##           C1   CTR1   QLT1
## [54.2,91.3[ 0.084  1.891  0.040
## [91.3,99.9[ 0.249 16.350  0.778
## [99.9,107[  0.175  8.123  0.503
## [107,116[   0.020  0.109  0.009
## [116,156]   -0.526 73.526  0.991

```

```

axe2.c=cbind(C2=AFC$col$coord[,2],CTR2=AFC$col$contrib[,2],QLT2=AFC$col$cos2[,2])
round(axe2.c,3)

```

```

##           C2   CTR2   QLT2
## [54.2,91.3[ 0.414 73.620  0.953
## [91.3,99.9[ -0.053  1.176  0.035
## [99.9,107[  -0.166 11.720  0.449
## [107,116[   -0.175 13.313  0.647
## [116,156]   -0.020  0.171  0.001

```